CLAIMS

What is claimed is:

1. An improved switching regulator for an implantable device, wherein the switching regulator includes control circuitry, and wherein the control circuitry provides at least one control parameter for the switching regulator, the improvement comprising:

a capacitor divider comprising at least two capacitors, and

a divided voltage, wherein the divided voltage is the voltage between two of the at least two capacitors;

wherein the control circuitry provided at least one control parameter for the switching regulator based on the divided voltage.

2. The improved switching regulator of Claim 1 wherein at least one of the at least two capacitors is a variable capacitor.

3. The improved switching regulator of Claim 2 wherein:

the switching regulator charges an energy storage device connected to a circuit node Vh;

the capacitor divider is connected between the node Vh and ground;

the control circuitry includes a reference voltage; and

the variable capacitor is set to a capacitance so that the divided voltage equals the reference voltage when a desired voltage is present at the node Vh.

4. The improved switching regulator of Claim 3 wherein the switching regulator includes an on command and an off command, wherein the switching regulator has a current output while the control circuitry is providing an on command, and wherein the switching regulator has no output while the control circuitry is providing an off command, and wherein the control circuitry provides an on command when the divided voltage is less than the reference voltage, and wherein the control circuitry provides an off command when the divided voltage is at least equal to the reference voltage.

5. The improved switching regulator of Claim 4 wherein the switching regulator includes a comparator, and wherein the comparator compares the divided voltage to a reference voltage.

6. The improved switching regulator of Claim 1 wherein the switching regulator includes a duty cycle, and wherein the improvement further includes providing at least two selectable duty cycles for the switching regulator, wherein one of the at least two selectable duty cycles is selected for use as the duty cycle based on a comparison of the divided voltage to a low duty cycle threshold.

7. The improved switching regulator of Claim 6 wherein the low duty cycle threshold corresponds to twice the voltage of a battery providing voltage and current to the switching regulator.

8. The improved switching regulator of Claim 1 wherein the at least two capacitors comprises at least two capacitors connected in series.

9. The improved switching regulator of Claim 1 wherein the control circuitry comprises the capacitor divided, a comparator, and control logic.

10. An improved power supply for an implantable device, the power supply comprising:

a battery;

control circuitry;

a step-up switching regulator inductor with an input connected to the battery and an output connected to a node Vout;

a first switch connected between the node Vout and ground, wherein the first switch is controlled by the control circuitry;

a diode including a cathode side and an anode side, wherein the cathode side is connected to the node Vout, and the anode side is connected to a node Vh;

a holding capacitor connected between the node Vh and ground;

a second switch controlled by the control circuitry;

a first lead;

a fixed capacitor;

a node Vcd; and

a variable capacitor;

wherein the second switch, the first lead, the fixed capacitor, the node Vcd, and the variable capacitor are electrically connected in series between Vh and ground;

a third switch connected between the first lead and ground, wherein the third switch is controlled by the control circuitry;

a fourth switch connected between the node Vcd and ground, wherein the fourth switch is controlled by the control circuitry; and

a comparator having a first input connected to the node Vcd, a second input connected to a reference voltage Vref, and a comparator output provided to the control circuitry.

11. The improved power supply of Claim 10 further including a fifth switch connected between the node Vh and an electrode lead extension, wherein the fifth switch is controlled by stimulation control.

12. The improved power supply of Claim 10 wherein the control circuitry provides control signals comprising:

a first control signal to the first switch adapted to control a frequency and a duty cycle of current flow through the step-up switching regulator inductor, thereby providing a modulated current surge through the diode to the holding capacitor, wherein the charge in the holding capacitor is increased each time the first switch is opened;

a second control signal to the second switch adapted to connect or disconnect the fixed capacitor and the variable capacitor from the node Vh, whereby the fixed capacitor and the variable capacitor may be shorted to ground without shorting the node Vh to ground; and

a third control signal to the third switch and a fourth control signal to the fourth switch, whereby the fixed capacitor and the variable capacitor may be shorted to ground to discharge the fixed capacitor and the variable capacitor.

13. The improved power supply of Claim 12, wherein the duty cycle is selectable from at least two selectable duty cycles.

14. The improved power supply of Claim 13, wherein the duty cycle selected from the at least two selectable duty cycles is selected to provide efficient operation of the power supply.

15. An improved switching regulator for an implantable device, wherein the switching regulator includes a duty cycle, the improvement comprising:

a capacitor divider;

a divided voltage between at least two capacitors of the capacitor divider; and

two or more selectable duty cycles wherein the duty cycle is selectable from the two or more selectable duty cycles based on the divided voltage.

16. The improved switching regulator of Claim 15 wherein the duty cycle is selectable from the at least two selectable duty cycles is based on the one of the at least two selectable duty cycles which provides efficient operation of the power supply.

17. The improved switching regulator of Claim 16 wherein the at least two selectable duty cycles comprise a first selectable duty cycle that is twenty percent or lower, and a second selectable duty cycle that is fifty percent or higher.

18. A method to efficiently operate a switching regulator, comprising:

providing a voltage input to a switching inductor;

providing a switched path from the switching inductor to ground;

providing a second path from the switching inductor to a storage device;

measuring the voltage level of the storage device using a capacitor divider; and

controlling the switching regulator based on the voltage level.

19. The method of Claim 18 wherein measuring the voltage level of the storage device using a capacitor divider comprises comparing a divided voltage between two of at least two capacitors to a reference voltage, and wherein

controlling the switching regulator further comprises turning the switching regulator off when the divided voltage is at least the reference voltage.

20. The method of Claim 18 wherein measuring the voltage level of the storage device using a capacitor divider comprises measuring a divided voltage between two of at least two capacitors to a reference voltage, and wherein controlling the switching regulator further comprises selecting a duty cycle for the switched inductor based on the divided voltage.